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The application and Implications of Gamma Radiation in Bread Wheat *(Triticum aestivum)*

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Abstract

The cultivars Khyber 87 (irrigated areas) and Pirsabak 91 (rainfed areas) of wheat were irradiated with varying level of gamma rays at Agriculture Research Institute, D.I. Khan during 1995-96. Observations were noted for plant height, tillers per plant, spikelets per spike, 1000-grain weight and grain yield per plant and found highly significant after analysis. Low level of radiation; 10 Krad and 15 Krad has shown some stimulation upon plant grow and yield, but slight higher level caused decline in mean value of corresponding character. Both varieties behaved different for quality and quantity attributes although radiation time and environmental factors were controlled. The overall performance of Pirsabak 91 was praiseworthy. Hence this variety is suggested to the farmers for multiplication and researchers for exploration.

Introduction

Atomic radiation and Radioactive isotopes are the main tool to propagate agricultural research focussing broad spectrum in crop production. Radiations cause abrupt change in genetic setup (induce mutation) in number of mechanism like deletion, insertion, transversion and translocation and provide wider range of variation and selection. More than 100 improved varieties of wheat rice, barley, oats, pears and flower, are being used in many parts of the world. Agroscientists of international repute Arain and Sadiqui (1976) and Bhowal *et al.* (1986) are concentrating upon mutation breeding in wheat to evolve high yielding varieites with rich protein contents, palatability and disease resistance. Apart from being during the past 8 or 9 decades of 20th century a revolutionary work in term of mutation breding have been advocated by many researchers like Karpinski *et al*. (1994) and Lee *et al*. (1990). Wheat *(Triticum aestivum)* often called "King of Cereals" is one of the world's premier crop with regard to its antiquity, acreage and importance with special reference to food. The effectiveness of gama radiation is not fully explored and optimal dose level regarding cereal crop is yet to be determined. Therefore, present research task was taken into consideration as an effort to unveil the mysteries relating mutation breeding.

Materials and Methods

Gamma radiation effects of different doses were studied on the wheat cultivators viz. Khyber 87 and Pirsabak 91 at Agricultural Research Institute (ARI) Ratta Kulachi, D.I. Khan during 1995-96. Data were collected for plant height, tiller per plants spikelets per spike, 1000-grain weights and grains yield per plant. Germ plasm was obtained from Cereal crop Research Institute (CCRI), Nowshera and irradiated at 10, 15, 20 and 25, Krad doses of gamma rays in Co^{60} gamma source at Nuclear Institute for Food and Agriculture (NIFA), Peshawar. Seeds were triplicated with the division of main plot (varieties) and sub plots (doses). Split plot was designed to reduce the experimental error. Each sub plot has the size of 5 x 1.20 m^2 with five rows of 5 meter length. Row to row distance was 30 cm and plant to plant distance was 15 cm. All recommended cultural practices were carefully adopted. At harvesting the produce of each sub plot was kept separately and tagged. These labelled lots were dried and threashed. Random observations were taken from 10 selected plants from each subplot. Recorded means were then subjected to statistical analysis using MSTAT-C Programme (Bricker, 1991).

Results and Discussion

Plant height (cm): Differences noted in mean for doses were found significant. However non significant results have been prescribed for varieties as well as interaction (Table 1).

Maximum plant (70.51 cm) was noted when 10 krad gamma radiation dose was applied. When radiation dose was increased upto 25 krad, plants obtained were of short stature i.e. 66.96 cm. Among varietal comparison Khyber 87 was taller (69.9 cm) than Pirsabak 91 (68.74 cm). Although difference in mean was significant (Table 2). There results have great analogy with the results already presented by Karapetjan (1960), Scossiroli *et al*. (1960) and Offutt (1962).

Tillers per plant (Nos.): Observations obtained for number of tillers per plant were non significant for variety, as well as for interaction between varieties and doses (Table 1). However means noted for doses alone were significant at 1 and 5 per cent probability level. Maximum number of tillers per plant (13.20) were observed when there was higher radiation dose i.e. 25 Krad. Whereas lowest radiation level (10 Krad) have shown less number of tillers (9.483). Like wise when seeds were non-irradiated (control) the number of tillers obtained were minimum i.e. 7.97. Peering into varietal comparison, the cultivar Khyber 87 has produced greater number of tillers (11.48) against Pirsabak 91 with value of 10.619. The difference in the varietal means were non consistence like interaction of varieties and doses. Thus it can be extracted that by the increase in the intensity of radiation dose number of tillers may be increased. Kaukis and Webster (1956) were of same opinion i.e. any increase in the intensity of radiation dose positively effect the number of tillers which consequently influence the yield of crop. Results also strike that different varieties response differently irrespective of the radiation level applied (Stadler, 1928).

Spikelets per spike (Nos.): Variability noted for number of spikelets per spike has been shown in Table 2. Data depict significant mean

Table 1: Mean squares for analysis of variance for different characters

S.O.V.	DF	Height	Tillers	Spikelets	1000-grains wt.	Grain yield
Var.	1	5.56NS	5.564NS	2.52**	37.95*	14.16*
Error	2	1.35	0.73	0.05	0.99	0.09
Dose	4	39.91**	29.46**	14.23**	7.54**	47.10**
Interaction	4	1.38NS	1.16NS	0.07NS	2.25**	0.17NS
Error	16	0.74	0.35	0.16	0.12	0.24

*= Significant; ** = Highly significant; NS = Non-significant

Table 2: Effect of gamma rays on various parameters in Khyber-87 and Pirsabak-91

		Radiation Doses (Krad)					
Parameters	Varieties	0	10	15	20	25	Mean
Plant height	Khyber-87	73.00	70.50	69.00	68.02	67.47	69.597
	Pirsabak-91	73.133	70.513	66.833	66.70	66.50	68.736
	Mean	73.067A	70.507B	67.917C	67.3580	66.9830	
Tillers/plant	Khyber-87	8.317	10.467	12.350	13.133	13.133	11.480
	Pirsabak-91	7.6133	8.500	12.110	11.583	13.267	10.619
	Mean	7.9750	9.483C	13.230A	12.3588	13.200A	
No. of spikes/	Khyber-87	23.217	22.273	21.200	20.167	19.233	21.210
spikelets	Pirsabak-91	23.750	22.717	21.817	20.500	20.167	21.790
	Mean	23.483A	22.475B	21.508C	20.333D	19.700E	
1000-grain	Khyber-87	35.333	37.433	35.280	35.833	34.488	35.673B
weight	Pirsabak-91	39.593	38.950	37.867	37.267	35.933	37.922A
	Mean	37.463E	38.192A	36.573C	36.550C	32.208D	
Grain yield	Khyber-87	25.680	25.413	21.480	20.207	19.550	22.466B
	Pirsabak-91	27.033	26.400	27.717	22.117	20.933	23.840A
	Mean	26.357A	25.907A	22.098B	21.162C	20.242D	

Any two means sharing same letters are not significantly different according to Duncan's Multiple Range Test.

differences for radiation level and variety, but unlike interaction (Table 1). It is also evident from the result that if no radiation (Control) dose in applied there is increase in number of spikelets per spike (23.48). However, on applying 10 Krad radiation dose there is slight decrease in number of spikelets per spike i.e. 22.47. Similarly subsequent decline in number of spikelets per spike is happened upon further increase in radiation dose. Minimum spikelets (19.70) were noted when 25 krad dose was applied. Pirsabak 91 greater number of spikelets (21.790) in comparison with the spikelet number in Khyber 87 (21.210). Scossiroli *et al*. (1960) were also of the opinion that higher radiation dose inhibit number of spikelets.

1000-grain weight (gm): Mean differences presented in Table 1 for 1000-grain weight were highly significant for radiation level and interaction. The probability level was reduced to non significant. When inferences made on varieties 1000-grains were massive (38.19 gm) when seeds were irradiated at 10 krad.

This dose was quite optimal as further increase in radiation level make the seeds lighter. 1000-grains were seems to be lighter (35.208 gm) when their seeds were subjected to 25 Krad radiation. Results presented in Table 2 also point that if seeds are not treated with radiation (control) they are comparatively heavier. Cultivar comparison again went in the favour of Pirsabak 91 where 1000-grains have weight 37.922 gm against 35.673 gm of Khyber 87.

Interaction studies prove that variety Pirsabak 91 has heavier 1000-grains (38.950 gm) for its seeds were treated at 10 Krad radiation dose. These results are in accordance with work already done by Gustafsson (1947).

Grains yield per plant (gm): Variance analysis for the grains yield indicates that the mean differences observed for radiation dose and variety are highly significant (Table 1). Whereas mean difference noted for interaction between variety and dose are non significant.

Overall analysis reveals that grain yield declines if radiated seeds are sown. Maximum yield per plant (26.357) was obtained in control (non-irradiated). However, it slightly declined when 10 Krad radiation dose was applied. Similarly minimum yield (20.42) was noticed upon increase in radiation dose i.e. 25 Krad.

Pirsabak 91 produced mean grain yield (23.84) when compared to Khyber 87 (22.46). Such type of behaviour of yield against the radiation dose has also been advocated by Harris (1962) who states that higher radiation dose inhibit the plant growth.

Above discussed results have exposed that quantity attributes like plant height spikelets per spike and 1000-grains weight were increased if seeds remained untreated to radiation. However, results may also be made promising if lower radiation doses i.e. 10-15 brad may applied. The important parameter, number of tillers reflects the above statements thus higher the radiation dose more will be number of tillers per plant. Present research also declare, that any radiation dose has negative effect upon yield parameter. Hence it is advisable for further selection that 10-15 Karad is optimal. Varietal contest proves cultivar Pirsabak 91 as the best for quantity and quality attributes. So farmers and research workers are suggested to concentrate upon the intricated phenomenon relating to genetic variability.

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